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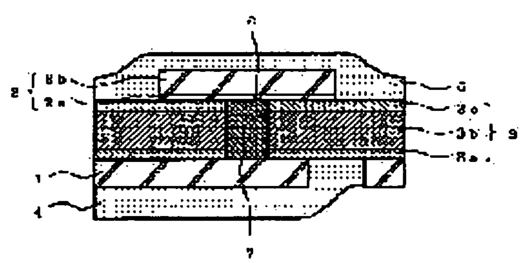
(71)Applicant : SONY CHEM CORP
(72)Inventor : TAKAHASHI SATOSHI
MASUYAMA TORU
NAMIKI HIDEJI

(54) DOUBLE-SIDED FLEXIBLE WIRING BOARD AND MANUFACTURE THEREOF

(57)Abstract:
PROBLEM TO BE SOLVED: To make conduction with high productivity and high reliability between wirings on both sides of a double-sided flexible wiring board, ensure high adhesion between an insulation layer (esp., polyimide layer) and conductive layers (esp., Cu layers) on both sides thereof, form wiring patterns by the finable additive method and avoid curling.

SOLUTION: A double-sided flexible wiring board has a laminate polyimide layer 3 composed of a first, second and third polyimide layers 3a, 3b, 3c between a lower and upper wiring layers 1, 2, the absolute value of the thermal linear expansion coefficient difference between a polyimide resin of the second polyimide layer 3b and metal materials of the wiring layers 1, 2 is within 5×10-6/K, and the third polyimide layer 3c is made of sulfo group-contg. polyimide. Metal plugs 7 filled in through-holes 6 formed through the laminate layer 3 by etching make conduction between the wiring layers 1, 2, and coverlays 4, 5 are disposed on the outsides of the wiring layers 1, 2.



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CLAIMS

[Claim(s)]
[Claim 1] It is the laminating polyimide layer which has the three-tiered structure of the 1st polyimide layer, the 2nd polyimide layer, and the 3rd polyimide layer between a lower layer wiring layer and the upper wiring layer. The absolute values of the difference of a heat ray expansion coefficient with the metallic material which constitutes the polyimide resin, lower layer wiring layer, and the upper wiring layer which constitute the 2nd polyimide layer are less than 5x10-6/K. The laminating polyimide layer by which the 3rd polyimide layer by the side of the upper wiring layer is constituted from sulfone radical content polyimide is pinched. The double-sided flexible patchboard with which the lower layer wiring layer and the upper wiring layer have flowed with the metal plug with which the through tube formed by the FOTORISO graphic method of a laminating polyimide layer was filled up by electrolysis plating, and the cover lay is arranged in the outside of a lower layer wiring layer and the upper wiring layer, respectively.
[Claim 2] The double-sided flexible patchboard according to claim 1 whose absolute values of the difference of the heat ray expansion coefficient of the 1st polyimide layer and the 3rd polyimide layer are less than 5x10-6/K.
[Claim 3] Sulfone radical content polyimide is guided from acid 2 anhydride and diamine, and they are acid 2 anhydride and the double-sided flexible patchboard of diamine according to claim 1 with which a sulfone radical exists in either at least.
[Claim 4] The double-sided flexible patchboard according to claim 3 with which a sulfone radical exists in acid 2 anhydride and the both sides of diamine.
[Claim 5] The double-sided flexible patchboard according to claim 1 to which the upper wiring layer consists of a metal thin film formed of the dry process, and electrolysis plated-metal film formed on it, and patterning is carried out with an additive process.
[Claim 6] The double-sided flexible patchboard according to claim 5 which has the two-layer structure of a nickel-Cu thin film / copper thin film where the metal thin film was formed of the spatter process.
[Claim 7] The double-sided flexible patchboard according to claim 5 whose electrolysis plated-metal film is electrolytic copper plating film.
[Claim 8] a lower layer wiring layer -- the metal layer for lower layer wiring -- subSUTORAKUTO -- the double-sided flexible patchboard according to claim 1 in which patterning is carried out by law.
[Claim 9] the manufacture approach of a double-sided flexible patchboard according to claim 1 -- setting -- the following (Process a) -(i): (a) Process; which forms the laminating polyimide precursor film of the three-tiered structure of the 3rd polyimide precursor film containing the 1st polyimide precursor film, the 2nd polyimide precursor film, and a sulfone radical in the front face of the metal layer for lower layer wiring
(b) Process which forms a through tube in the laminating polyimide precursor film with a FOTORISO graphic method;
(c) Process which imide-izes the laminating polyimide precursor film and forms the laminating polyimide layer of the three-tiered structure of the 1st polyimide layer, the 2nd polyimide layer, and the 3rd polyimide layer;
(d) Process which arranges a protective coat in the inferior surface of tongue of the metal layer for lower layer wiring;
(e) Process which embeds electric conduction material with electrolysis plating at the through tube formed in the laminating polyimide layer, and forms a metal plug in it;
(f) Process which forms the upper wiring layer in the 3rd polyimide layer top face of a laminating polyimide layer with an additive process;
(g) Process which arranges a cover lay in the upper wiring layer;

(h) the metal layer for lower layer wiring after removing the protective coat arranged in the inferior surface of tongue of the metal layer for lower layer wiring -- subSUTORAKUTO -- process which carries out patterning to a lower layer wiring layer by law; And (i) The manufacture approach which comes to contain in a lower layer wiring layer the process which arranges a cover lay.

[Claim 10] A process (f) is the following process (f1) -(f4): (f1). Process which forms a metal thin film in the 3rd polyimide layer top face of a laminating polyimide layer according to a dry process;

(f2) Process which forms the plating resist film of the pattern corresponding to the upper wiring on a metal thin film;

(f3) Process which forms the electrolysis plated-metal film on a metal thin film with electrolysis plating; and (f4) -- The manufacture approach according to claim 9 which consists of a process which forms the upper wiring layer by removing the plating resist film and performing software etching.

[Claim 11] The manufacture approach of claim 10 which forms the metal thin film of the two-layer structure of a nickel-Cu thin film / copper thin film according to a spatter process as a metal thin film.

[Claim 12] The manufacture approach according to claim 10 which forms the coppering film with electrolysis plating as electrolysis plated-metal film.

[Claim 13] A process (h) is the following process (h1) -(h3): (h1). Process which removes the protective coat arranged in the inferior surface of tongue of the metal layer for lower layer wiring, and forms the plating resist film of the pattern corresponding to lower layer wiring in the inferior surface of tongue of the metal layer for lower layer wiring;

(h2) Process etched until the 1st polyimide layer of a laminating polyimide layer exposes the metal layer for lower layer wiring; and (h3) -- The manufacture approach according to claim 9 which consists of a process which forms a lower layer wiring layer by removing the plating resist film prepared in the inferior surface of tongue of the metal layer for lower layer wiring.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to a double-sided flexible patchboard and its manufacture approach.
[0002]
[Description of the Prior Art] A double-sided flexible patchboard forms a through tube in the double-sided copper-clad flexible substrate of the structure where the copper layer (conductive layer) was arranged in both sides of a polyimide layer (insulating layer), with NC drill. while making an electroless deposition copper thin film adhere to the wall of a through tube, forming SURUHORU by forming the electrolytic copper plating film further, protecting the wall of SURUHORU subsequently and securing a flow -- the copper layer of substrate both sides -- subSUTORAKUTO -- it is manufactured by forming a circuit by law.
[0003] Here, it is the typical production approach of a double-sided copper-clad flexible substrate (1). How to paste up copper foil with adhesives on both sides of the polyimide film which is an insulating material by the laminating method;
(2) How to prepare coating and the dry film for two thermoplastic polyimide resin solutions on copper foil, pile up thermoplastic polyimide resin of each other, and laminate under an elevated temperature and high pressure;
(3) Three approaches more than approach; which forms a metal thin film in both sides of the polyimide film (for example, Kapton (Du Pont), APIKARU (Kaneka) which consist of pyromellitic acid 2 anhydride and diamino diphenyl ether; YUPI REXX S which consists of diphenyl tetracarboxylic dianhydride and a p phenylenediamine (Ube Industries)) of marketing of the monolayer structure which consists of acid 2 anhydride and diamine with vacuum deposition, and forms a metal deposit with electrolysis plating on it further are learned.
[0004]
[Problem(s) to be Solved by the Invention] However, when using NC drill in order to open a through tube in a double-sided copper-clad flexible substrate in case a double-sided flexible patchboard is produced, in order quite [in equipment] big plant-and-equipment investment is needed and to puncture one through tube at a time, there is a problem that productivity is low. And it is easy to be easy to generate weld flash on the puncturing edge front face of a through tube, and there is also a problem that a puncturing configuration is not fixed, either. Furthermore, cutting powder adheres to a through tube wall, and there is also a problem of reducing the flow dependability of SURUHORU. Moreover, as an approach of applying, in case the circuit patternizing of the copper layer of a double-sided flexible substrate is carried out, formation of a fine pattern cannot adopt an easy additive process, but the problem that it is limited to the subSUTORAKUTO method its twist was also inferior also has it. Moreover, when patterning of the double-sided copper layer of a double-sided flexible substrate is carried out to a mutually different pattern from the difference of a heat ray expansion coefficient with a copper layer and a polyimide layer, curl arises in a double-sided flexible patchboard by the case, and there is a problem of causing trouble to a mounting activity.
[0005] Moreover, even if it faces production of a double-sided copper-clad flexible substrate, there is a problem which is explained below in each approach (1) - (3).
[0006] (1) The thermal resistance of adhesives is not enough, moreover, in the present condition, since copper foil with thick thickness is used and copper foil is also plated by coincidence at the time of SURUHORU plating, copper foil becomes thick to an ununiformity, therefore the thing corresponding to a detailed pattern, wirebonding, etc. cannot be manufactured.
[0007] (2) Since the laminator which can set up lamination temperature and welding pressure highly is

needed when heat-resistant good thermoplastic polyimide resin is used, in order to produce a heat-resistant good flexible substrate, the amount of capital investment increases, profitability falls, and, moreover, productivity also falls.
[0008] (3) The adhesion force between a metal thin film and a polyimide film is not enough, and the flow dependability of level which is required of a patchboard cannot be secured.
[0009] This invention tends to solve the technical problem of the above Prior art, makes it flow through between wiring of both sides of a double-sided flexible patchboard with high productivity and high dependability, and secures high adhesion, enables it to form it with the additive process which can moreover finize a circuit pattern between an insulating layer (especially polyimide layer) and the conductive layer (especially copper layer) of the both sides, and aims at making it not produce curl further.
[0010]
[Means for Solving the Problem] The above-mentioned purpose of this invention is attained by the following double-sided flexible patchboard and its manufacture approach of this invention.
[0011] This invention between a lower layer wiring layer and the upper wiring layer Namely, the 1st polyimide layer, It is the laminating polyimide layer which has the three-tiered structure of the 2nd polyimide layer and the 3rd polyimide layer. The absolute values of the difference of a heat ray expansion coefficient with the metallic material which constitutes the polyimide resin, lower layer wiring layer, and the upper wiring layer which constitute the 2nd polyimide layer are less than 5x10-6/K. The laminating polyimide layer by which the 3rd polyimide layer by the side of the upper wiring layer is constituted from sulfone radical content polyimide is pinched. The lower layer wiring layer and the upper wiring layer have flowed with the metal plug with which the through tube formed by the FOTORISO graphic method of a laminating polyimide layer was filled up by electrolysis plating. The double-sided flexible patchboard with which the cover lay is arranged in the outside of a lower layer wiring layer and the upper wiring layer, respectively is offered.
[0012] Moreover, it sets to the manufacture approach of the above-mentioned double-sided flexible patchboard, and this invention is the following (Process a) -(i): (a). Process which forms the laminating polyimide precursor film of the three-tiered structure of the 3rd polyimide precursor film containing the 1st polyimide precursor film, the 2nd polyimide precursor film, and a sulfone radical in the front face of the metal layer for lower layer wiring;
(b) Process which forms a through tube in the laminating polyimide precursor film with a FOTORISO graphic method;
(c) Process which imide-izes the laminating polyimide precursor film and forms the laminating polyimide layer of the three-tiered structure of the 1st polyimide layer, the 2nd polyimide layer, and the 3rd polyimide layer;
(d) Process which arranges a protective coat in the inferior surface of tongue of the metal layer for lower layer wiring;
(e) Process which embeds electric conduction material with electrolysis plating at the through tube formed in the laminating polyimide layer, and forms a metal plug in it;
(f) Process which forms the upper wiring layer in the 3rd polyimide layer top face of a laminating polyimide layer with an additive process;
(g) Process which arranges a cover lay in the upper wiring layer;
(h) the metal layer for lower layer wiring after removing the protective coat arranged in the inferior surface of tongue of the metal layer for lower layer wiring -- subSUTORAKUTO -- process which carries out patterning to a lower layer wiring layer by law; And (i) The manufacture approach which comes to contain in a lower layer wiring layer the process which arranges a cover lay is offered.
[0013] Here, it is a process (f) The following process (f1) -(f4): (f1) Process which forms a metal thin film in the 3rd polyimide layer top face of a laminating polyimide layer according to a dry process;
(f2) Process which forms the plating resist film of the pattern corresponding to the upper wiring on a metal thin film;
(f3) Process which forms the electrolysis plated-metal film on a metal thin film with electrolysis plating; and (f4) -- It is desirable by removing the plating resist film and performing software etching to constitute from a process which forms the upper wiring layer.
[0014] Moreover, it is a process (h) The following process (h1) -(h3): (h1) Process which removes the protective coat arranged in the inferior surface of tongue of the metal layer for lower layer wiring, and forms the plating resist film of the pattern corresponding to lower layer wiring in the inferior surface of tongue of the metal layer for lower layer wiring;

(h2) Process etched until the 1st polyimide layer of a laminating polyimide layer exposes the metal layer for lower layer wiring; and (h3) -- It is desirable to constitute from a process which forms a lower layer wiring layer by removing the plating resist film prepared in the inferior surface of tongue of the metal layer for lower layer wiring.
[0015]
[Embodiment of the Invention] Hereafter, this invention is explained to a detail.
[0016] The laminating polyimide layer 3 which has the three-tiered structure of 1st polyimide layer 3a, 2nd polyimide layer 3b, and 3rd polyimide layer 3c between the lower layer wiring layer 1 and the upper wiring layer 2 is pinched, and the double-sided flexible patchboard of this invention has the structure where covers lay 4 and 5 were allotted on each outside of the lower layer wiring layer 1 and the upper wiring layer 2, as shown in drawing 1 .
[0017] In this invention, the absolute value of the difference of a heat ray expansion coefficient with the metallic material which constitutes the polyimide resin, the lower layer wiring layer 1, and the upper wiring layer 2 which constitute 2nd polyimide layer 3b is adjusted within 5x10-6/K. Thereby, it cannot be based on the contents of the usual heat histories (ordinary temperature preservation, solder DIP processing, etc.), but generating of curl of a double-sided flexible patchboard can be controlled.
[0018] in addition, the point that the heat ray expansion coefficient of the metallic material of the lower layer wiring layer 1 generally used to a double-sided flexible patchboard by the heat ray expansion coefficient of 2nd polyimide layer 3b and the upper wiring layer 2 is the numeric value shown in Table 1 -- taking an example -- desirable -- x(10-25) 10-6 / K -- they are x(17-23) 10-6/K more preferably.
[0019]
[Table 1]

材質	熱線膨張係数（×１０$^{-6}$／K）文献値	熱線膨張係数（×１０$^{-6}$／K）実測値
銅箔	１６～２０	１８～１９
ＳＵＳ３０４箔	１６～１７	１７～１８
ＳＵＳ４３０箔	１０～１１	
アルミニウム箔	２２～２５	２２～２３
ベリリウム銅箔	１７～１８	
リン青銅箔	１７～１８	

[0020] In the double-sided flexible patchboard of this invention, 3rd polyimide layer 3c arranged in the upper wiring layer 2 side of 2nd polyimide layer 3b consists of sulfone radical content polyimide. By existence of a sulfone radical, the adhesion force between the metal thin films formed of a dry process on it can be raised. And the adhesion stabilized also by the usual heat history is securable.
[0021] In addition, although 1st polyimide layer 3a may consist of polyimide which does not contain a sulfone radical, it is desirable like 3rd polyimide layer 3c to consist of sulfone radical content polyimide.
[0022] Here, what imide-ized the sulfone radical content polyamic acid guided from acid 2 anhydride and diamine as sulfone radical content polyimide can be used preferably, and the sulfone radical originates in acid 2 anhydride and the sulfone radical of diamine which exists in either beforehand at least. The sulfone radical content polyimide obtained when a sulfone radical exists in acid 2 anhydride and the both sides of diamine especially can be used preferably.
[0023] As an example of acid 2 anhydride, pyromellitic acid 2 anhydride (PMDA), 3 and 4, 3', and 4'-biphenyl tetracarboxylic dianhydride (BPDA), 3 and 4, 3', and 4'-benzophenone tetracarboxylic dianhydride (BTDA), 3, 3', 4, and 4'-diphenylsulfone tetracarboxylic dianhydride (DSDA) is mentioned preferably.
[0024] As an example of diamine, 4 and 4'-diamino diphenyl ether (DPE), p phenylenediamine (PDA), 4, and 4'-diamino benzanilide (DABA), 4, and 4'-bis(p-amino phenoxy) diphenylsulfone (BAPS) is mentioned preferably.
[0025] Moreover, as for the heat ray expansion coefficient of 1st polyimide layer 3a and 3rd polyimide layer 3c, it is desirable that the absolute values of the point the effectiveness's [which controls curl] to both difference are less than 5x10-6/K. Of course, it may be the same and may be almost the same as that of 2nd polyimide layer 3b.
[0026] It is desirable that the thickness of 2nd polyimide layer 3b is thicker than 1st polyimide layer 3a and

3rd polyimide layer 3c about the thickness of 1st polyimide layer 3a, 2nd polyimide layer 3b, and 3rd polyimide layer 3c. Since as for the thickness of 2nd polyimide layer 3b it will become difficult to store a heat ray expansion coefficient in the range of x(10-25) 10-6/K if too thin, the laminating polyimide layer itself will become hard if too thick, and the roll volume of predetermined magnitude becomes impossible, specifically, it is more preferably set to 10-50 micrometers 5-100 micrometers. moreover -- if the thickness of 1st polyimide layer 3a and 3rd polyimide layer 3c is too thin -- forming membranes -- being hard -- since the heat ray expansion coefficient and difference of a metallic material of the heat ray expansion coefficient of the laminating polyimide layer 3 whole which is making it dependent on the heat ray expansion coefficient of 2nd polyimide layer 3b, the lower layer wiring layer 1, and the upper wiring layer 2 may become large if too thick, 1-10 micrometers is more preferably set to 2-5 micrometers.
[0027] In the double-sided flexible patchboard of this invention, the lower layer wiring layer 1 and the upper wiring layer 2 have flowed with the metal plug 7 with which the through tube 6 formed by the FOTORISO graphic method was filled up by electrolysis plating. Since a through tube 6 is formed in the laminating polyimide precursor film before imide-izing of the laminating polyimide layer 3 instead of NC drill in a uniform and good precision using the FOTORISO graphic method in which detailed PATANIGU is possible, it can make it flow through between wiring of both sides of a double-sided flexible patchboard by high productivity, high dependability, and the detailed pattern.
[0028] As a metal plug 7, it can constitute from various metals with which a through tube 6 can be filled up with electrolysis plating, and the copper plug from a copper sulfate bath can be used preferably.
[0029] as the lower layer wiring layer 1 -- metal layers for lower layer wiring, such as copper foil, -- subSUTORAKUTO -- what carried out patterning by law can be used preferably.
[0030] As an upper wiring layer 2, what carried out patterning of the electrolysis plated-metal film 2b formed on it to metal thin film 2a formed of the dry process with the additive process is used so that it may mention later. Therefore, the upper wiring layer 2 can be used as the wiring layer of a fine pattern.
[0031] Here, although metal thin film 2a is formed of a dry process, the general physical vapor deposition (for example, a vacuum deposition process, an ion plating process, a spatter process, etc.) as a dry process can be used.
[0032] As metal thin film 2a, the thin film of nickel, Co, Cr, Zr, Pd, Cu(s), or these alloys is desirable. When gold plate-proof nature, tinning-proof nature, etc. are especially taken into consideration, the two-layer structure thin film of the nickel-Cu thin film (50-500A thickness) / copper thin film (100-2000A thickness) formed of a spatter process is desirable.
[0033] As electrolysis plated-metal film 2b, the electrolytic copper plating film of 5-50-micrometer thickness is desirable. The formation conditions of the electrolytic copper plating film can be chosen suitably, for example, can be formed by copper sulfate bath plating of current density 0.2 - 10 A/dm2.
[0034] In addition, it is desirable to perform surface treatment processing of glow discharge processing, plasma electrodischarge treatment (gas or mixed-gas ambient atmospheres, such as nitrogen oxide gas, oxygen, and an argon), UV irradiation processing, etc., etc. to the front face of 3rd polyimide layer 3c in advance of formation of metal thin film 2a from the point which raises adhesion.
[0035] It can constitute like the cover lay used in the conventional double-sided flexible patchboard as covers lay 4 and 5, for example, can form by carrying out dry laminate of the polyimide film with adhesives, or carrying out spreading desiccation of the thermoplastic polyimide resin coating liquid, or carrying out spreading desiccation and imide-izing a polyamic acid varnish.
[0036] The double-sided flexible patchboard of this invention can be manufactured according to following process (a) - (i). It explains for every process, referring to a drawing.
[0037] Process (a)
The laminating polyimide precursor film 22 which consists of 3rd polyimide precursor film 22c containing 1st polyimide precursor film 22a, 2nd polyimide precursor film 22b, and a sulfone radical is formed in the front face of the metal layer 21 for lower layer wiring (drawing 2 (a)).
[0038] It dries with continuous stoves (an arch type furnace, floating furnace, etc.), and polyimide precursor film 22a is produced so that coating of the polyamic acid varnish for the 1st polyimide film formation may be carried out to the top face of the metal layer 21 for lower layer wiring by a comma coating machine, a knife coating machine, the roll coater, the GURABIYA coating machine, the lip coating machine, a die coating machine, etc. and it may specifically fit in it at within the limits whose residual volatile-matter contents (a solvent, water produced by condensation) are 20 - 30 % of the weight, and so that foaming may not arise. Here, there is a possibility that the adhesion of the 1st polyimide layer and the 2nd polyimide layer may become it inadequate that a residual volatile matter content is less than 20 % of the weight, and if it

exceeds 30 % of the weight, the adhesion reinforcement or contraction between the 1st polyimide layer and the 2nd polyimide layer will not be stable.
[0039] In addition, in this specification, a residual volatile matter content means the weight percent (% of the weight) of all the volatile components in the polyimide precursor film.
[0040] Next, on 1st polyimide precursor film 22a, coating of the polyamic acid varnish for the 2nd polyimide film formation is carried out similarly, it dries so that it may be settled at within the limits whose residual volatile matter content is 30 - 50 % of the weight, and 2nd polyimide precursor film 22b is produced. Since foaming will arise on the occasion of imide-izing if there is a possibility that the adhesion of the 1st polyimide layer and the 2nd polyimide layer may become it inadequate that a residual volatile matter content is less than 30 % of the weight here and it exceeds 50 % of the weight, it is not desirable.
[0041] Next, on 2nd polyimide precursor film 22b, coating of the polyamic acid varnish for the 3rd polyimide film formation is carried out similarly, it dries so that it may be settled at within the limits whose residual volatile matter content is 30 - 50 % of the weight, and 3rd polyimide precursor film 22c is produced. Thereby, the laminating polyimide precursor film 22 of a three-tiered structure is obtained.
[0042] Process (b)
Next, a through tube 23 is formed in the laminating polyimide precursor film 22 with a FOTORISO graphic method (drawing 2 (b)).
[0043] The alkali-proof photoresist (for example, NR-41, Sony Chemicals Corp. make) in which development is possible is specifically applied to the laminating polyimide precursor film 22 with a conventional method in neutrality or a weak acidic water solution, negatives are exposed and developed through a SURUHORU pattern mask, and etching resist is formed.
[0044] Next, the laminating polyimide precursor film 22 is etched in a potassium-hydroxide water solution 10% through etching resist, and a through tube 23 is formed. Exfoliation removal of the etching resist can be carried out by weakness - inside aqueous acids.
[0045] Process (c)
Next, the laminating polyimide precursor film 22 is imide-ized, and the laminating polyimide layer 24 of the three-tiered structure of 1st polyimide layer 24a, 2nd polyimide layer 24b, and 3rd polyimide layer 24c is formed (drawing 2 (c)).
[0046] At 7 - 10%, imide-ization can perform preferably 210-250 degrees C of residual volatile-matter contents by heat-treatment with a continuous furnace with a temperature of 230-240 degrees C so that it may become 50% or less about the rate of imide-izing (value which computed the amount of extinction and this sample of absorption wavelength 1780cm-1 of an imide radical from the percentage to the amount of extinction when imide-izing 100% by the infrared absorption analysis of a spectrum (surface reflection method (ATR method))). Since it will become easy to produce blocking if a residual volatile-matter content cannot fully control curl as it is less than 7%, but it exceeds 10% here, it is not desirable. Moreover, if the rate of imide-izing exceeds 50%, curl cannot fully be controlled.
[0047] Moreover, if less than 210 degrees C [a residual volatile-matter content] become being whenever [stoving temperature] with less than 7% and it exceeds 250 degrees C, the rate of imide-izing becomes 50% or more and is not desirable.
[0048] Process (d)
A protective coat 25 is arranged in the inferior surface of tongue of the metal layer 21 for lower layer wiring (drawing 2 (d)). What is necessary is just to specifically stick an acid-proof protection film with adhesives (for example, PET8184 (Sony Chemicals Corp. make)) on the metal layer 21 for lower layer wiring directly.

[0049] Process (e)
At the through tube 23 formed in the laminating polyimide layer 24, electric conduction material is embedded with electrolysis plating, and the metal plug 26 is formed in it (drawing 2 (e)). For example, a copper plug is formed by electrolytic plating from a copper sulfate bath.
[0050] Here, as for the height of the metal plug 26, it is desirable to be referred to as 0-+5 micrometers of the thickness of the laminating polyimide layer 24. + When it exceeds 5 micrometers, there is an inclination for flow dependability to fall.
[0051] Process (f)
Next, the upper wiring layer 27 is formed in the front face of 3rd polyimide layer 24c of the laminating polyimide layer 24 of the side which the metal plug 26 has exposed with an additive process (drawing 2 (f)).
[0052] Specifically, it is desirable to form the following processes (f1) and the upper wiring layer 27 by -

(f4).
[0053] Process (f1)
Metal thin film 27a is formed in the 3rd polyimide layer 24c top face of the laminating polyimide layer 24 according to a dry process (drawing 3 (f1)).
[0054] Here, although the general physical vapor deposition as a dry process can be used, a spatter process is desirable especially.
[0055] Especially as an ingredient of metal thin film 27a, when gold plate-proof nature, tinning-proof nature, etc. are taken into consideration, the two-layer structure thin film of the nickel-Cu thin film (50-500A thickness) / copper thin film (100-2000A thickness) formed of a spatter process is desirable.
[0056] In addition, it is desirable to perform surface treatment processing of glow discharge processing, plasma electrodischarge treatment, etc. to the front face of 3rd polyimide layer 24c in advance of formation of metal thin film 27a from the point which raises adhesion.
[0057] Process (f2)
On metal thin film 27a, the plating resist film 28 of the pattern corresponding to the upper wiring is formed (drawing 3 (f2)).
[0058] Process (f3)
Electrolysis plated-metal film 27b is formed on metal thin film 27a with electrolysis plating (drawing 3 (f3)). As electrolysis plated-metal film 27b, the electrolytic copper plating film of 5-50-micrometer thickness is desirable. The formation conditions of the electrolytic copper plating film can be chosen suitably, for example, can be formed by copper sulfate bath plating of current density 0.2 - 10 A/dm2.
[0059] Process (f4)
The upper wiring layer 27 is formed by removing the plating resist film 28, and weak acid's etc. performing software etching and removing exposed metal thin film 27a (drawing 3 (f4), drawing 2 R> 2 (f)).
[0060] Process (g)
A cover lay 29 is arranged in the upper wiring layer 27 with a conventional method (drawing 2 (g)).
[0061] Process (h)
the metal layer 21 for lower layer wiring after removing the protective coat 25 arranged in the inferior surface of tongue of the metal layer 21 for lower layer wiring -- subSUTORAKUTO -- patterning is carried out to the lower layer wiring layer 30 by law (drawing 2 (h)).
[0062] Specifically, the following processes (h1) and the lower layer wiring layer 30 can be formed by -(h3).
[0063] Process (h1)
The protective coat 25 arranged in the inferior surface of tongue of the metal layer 21 for lower layer wiring is removed, and the plating resist film 31 of the pattern corresponding to lower layer wiring is formed in the inferior surface of tongue of the metal layer 21 for lower layer wiring (drawing 4 (h1)).
[0064] Process (h2)
It etches until 1st polyimide layer 24a of the laminating polyimide layer 24 exposes the metal layer 21 for lower layer wiring (drawing 4 (h2)).
[0065] Process (h3)
The lower layer wiring layer 30 is formed by removing the plating resist film 31 prepared in the inferior surface of tongue of the metal layer 21 for lower layer wiring (drawing 4 (h3), drawing 2 (h)).
[0066] Process (i)
A cover lay 32 is arranged in the lower layer wiring layer 30 (drawing 2 (i)). Thereby, the double-sided flexible patchboard of this invention as shown in drawing 1 is obtained.
[0067] Between double-sided wiring has flowed through the double-sided flexible patchboard of this invention obtained as mentioned above with high productivity and high dependability, and its adhesion between a laminating polyimide layer and the wiring layer of the both sides is good, and can form it with the additive process which can moreover finize a circuit pattern about the upper wiring layer, and curl does not produce it further.
[0068]
[Example] Hereafter, this invention is explained concretely.
[0069] P phenylenediamine (PDA, Mitsui Chemicals, Inc. make) 0.433kg (4.00 mols) and 4 and 4'-diamino diphenyl ether (made in [Wakayama energy-ized company] DPE) 0.801kg (4.00 mols) were dissolved in the 60l. reaction vessel with example of reference A1 (preparation of a polyamic acid varnish which has a sulfone radical) jacket under nitrogen-gas-atmosphere mind at solvent N-methyl-pyrrolidone (NMP, Mitsubishi Chemical make) about 35.3kg. Then, it was made to react in 25 degrees C for 3 hours, adding

gradually 2.690kg (DSDA, New Japan Chemical Co., Ltd. make) (8.08 mols) of 3, 3', 4, and 4'-diphenylsulfone tetracarboxylic dianhydride. This prepared about 10% of solid content, and the polyamic acid varnish of viscosity 20 Pa-S (25 degrees C).

[0070] After applying the obtained polyamic acid varnish on copper foil and dispersing a solvent with a 80-160-degree C continuous furnace, the temperature up of the ambient temperature was carried out to 230-350 degrees C, and at 350 degrees C, it processed for 30 minutes and imide-ized. And the monolayer polyimide film of 25-micrometer thickness was obtained by carrying out etching removal of the copper foil with a ferric-chloride solution. The heat ray expansion coefficients (the measuring device used: thermal mechanical analyzer (TMA/SCC150CU, product made from SII (the **** method: working loads 2.5g-5g))) of the obtained polyimide film were 36x10-6/K.

[0071] Like the example A1 of example of reference A2 (preparation of polyamic acid varnish which does not have sulfone radical) reference, 4 and 4'-diamino diphenyl ether (made in [Wakayama energy-ized company] DPE) 0.400kg (2.0 mols), 4 and 4'-diamino benzanilide (DABA, Wakayama energy-ized company make) 1.81kg (8.0 mols) was dissolved in solvent N-methyl-pyrrolidone (NMP, Mitsubishi Chemical make) about 46kg under nitrogen-gas-atmosphere mind. Then, it was made to react in 50 degrees C for 3 hours, adding gradually 2.97kg (BPDA, Mitsubishi Chemical make) (10.1 mols) of 3, 4, 3', and 4'-biphenyl tetracarboxylic dianhydride. This prepared about 10% of solid content, and the polyamic acid varnish of viscosity 20 Pa-S (25 degrees C).

[0072] The monolayer polyimide film was obtained by processing the obtained polyamic acid varnish like the example A1 of reference (heat-ray expansion coefficient: 18x10-6/K).

[0073] 4 and 4'-diamino diphenyl ether (made in [Wakayama energy-ized company] DPE) 2.00kg (10.0 mols) was dissolved in solvent N-methyl-pyrrolidone (NMP, Mitsubishi Chemical make) about 46kg under nitrogen-gas-atmosphere mind like the example A1 of the example A3 (preparation of polyamic acid varnish which does not have sulfone radical) reference of reference. Then, it was made to react in 50 degrees C for 3 hours, adding gradually 2.96kg (BPDA, Mitsubishi Chemical make) (10.1 mols) of 3, 4, 3', and 4'-biphenyl tetracarboxylic dianhydride. This prepared about 10% of solid content, and the polyamic acid varnish of viscosity 15 Pa-S (25 degrees C).

[0074] The monolayer polyimide film was obtained by processing the obtained polyamic acid varnish like the example A1 of reference (heat-ray expansion coefficient: 35x10-6/K).

[0075] On the electrolytic copper foil (CF-T9-LP, the Fukude metal company make) of example 1 (formation of laminating polyimide precursor film) 18-micrometer thickness, and 540mm width of face, it applied and the polyamic acid varnish of example A3 of reference was dried so that it might become the dry thickness of 2 micrometers, and the 1st polyimide precursor film (25% of residual volatile matter contents) was formed.

[0076] Besides, it applied and the polyamic acid varnish of the example A2 of reference was dried so that the thickness after imide-izing might be set to 22 micrometers, and the 2nd polyimide precursor film was formed. The residual volatile-matter content of the laminating polyimide precursor film with which the 1st polyimide precursor film and the 2nd polyimide precursor film were aligned was 30%.

[0077] Furthermore, on this, it applied and the polyamic acid varnish of the example A1 of reference was dried so that the thickness after imide-izing might be set to 3 micrometers, and the 3rd polyimide precursor film was formed. The residual volatile-matter content of the laminating polyimide precursor film with which the 1st polyimide precursor film, the 2nd polyimide precursor film, and the 3rd polyimide precursor film were aligned was 38%.

[0078] (Formation and imide-izing of SURUHORU) On the laminating polyimide precursor film, the good alkali-proof photoresist (NR-41, Sony Chemicals Corp. make) was applied so that the thickness after solvent desiccation might be set to 20 micrometers.

[0079] Exposure development of this photoresist was carried out at the pattern corresponding to a SURUHORU pattern, the etching-resist layer was formed, and with 10% potassium-hydroxide water solution and warm water, the laminating polyimide precursor film was etched until copper foil was exposed, and SURUHORU (diameter of 0.3mm) was formed. Then, the etching-resist layer was removed with the conventional method.

[0080] The laminating polyimide precursor film with which SURUHORU was formed was heat-treated all over the 230-degree C continuous furnace. The residual volatile-matter content at this time was 7.9%, and the rate of imide-izing by infrared-spectrum analysis was 20%. Then, in order to imide--ization-process further, 100m of heat-treated layered products was involved in, it supplied in the batch oven of nitrogen-gas-atmosphere mind (0.1% or less of oxygen densities), the temperature up was carried out to 350 degrees C

over 1 hour, and it held for 15 minutes at 350 degrees C so that copper foil might become stainless steel ** with a diameter of 250mm inside. Then, the temperature was lowered to 200 degrees C under nitrogen-gas-atmosphere mind, and it cooled in atmospheric air. In this way, the one side copper-clad polyimide substrate with a thickness of 22 micrometers with which SURUHORU was formed was obtained.
[0081] (Restoration of the copper plug of SURUHORU) The copper-foil face of an one side copper-clad polyimide substrate is protected on a protection tape, the electrolysis (current density 0.8 A/dm2) deposit of the copper was carried out into SURUHORU from the copper-sulfate plating bath (5%) by having used copper foil as the cathode, and the copper plug was formed.
[0082] (Formation of the metal thin film by the dry process to the 3rd polyimide layer front face) The plasma dry cleaner (PX-1000, product made from March) was used, and degree of vacuum 80mmTorr and the argon plasma using the RF generator of output 120W were irradiated on the 3rd polyimide layer front face.
[0083] Subsequently, the nickel-Cu alloy thin film with a thickness of 150A was formed from the nickel50%/Cu50% alloy target by the DC magnetron sputtering method.
[0084] Furthermore, the copper thin film with a thickness of 1000A was formed from the copper target.
[0085] (Formation of the upper wiring layer by the additive process) a metal thin film top -- a photoresist film (SPG152, Asahi Chemical Co., Ltd. make) -- laminating -- photograph RISOGURAFU -- the upper wiring resist pattern was formed by law, and the copper of 12-micrometer thickness was deposited by electrolytic plating. In order to measure bond strength, the copper pattern with a width of face of 0.5mm was produced.
[0086] After removing a resist pattern, the upper wiring layer was formed by carrying out software etching removal of the exposed metal thin film in 3% hydrogen peroxide / sulfuric-acid water solution. And according to the conventional method, the cover lay was formed on the upper wiring layer.
[0087] (SubSUTORAKUTO formation of the lower layer wiring layer by law) the copper foil top for lower layer wiring -- a photoresist film (SPG152, Asahi Chemical Co., Ltd. make) -- laminating -- photograph RISOGURAFU -- the etching resist pattern corresponding to a lower layer circuit pattern was formed by law, patterning of the copper was carried out with the acid etching reagent, and the lower layer wiring layer was formed by removing an etching resist pattern. Finally according to the conventional method, the cover lay was formed on the lower layer wiring layer. Thereby, the double-sided flexible patchboard without curl was obtained.
[0088] (Evaluation) About the double-sided flexible patchboard of an example 1, it is JISC about the bond strength between the bond strength between a lower layer wiring layer and the 1st polyimide layer, the upper wiring layer, and the 3rd polyimide layer. It measured by the approach (90-degree exfoliation by 1.59mm width of face) according to 6471. Moreover, the hot oil trial (260-degree-C10 -20-degree-C heat cycle for 10 seconds per second) was performed to the double-sided flexible patchboard, and it investigated in what cycle the abnormalities in a flow of SURUHORU would arise. The obtained result is shown in Table 2.
[0089] In addition, coating of the polyimide resin solution which does not contain the sulfone radical on copper foil was carried out as an example 1 of a comparison, the double-sided flexible substrate (SC18-50-18WE, the Nippon Steel chemistry company make) which piled up polyimide resin of each other and was laminated under an elevated temperature and high pressure was used, it punctured with NC drill according to the conventional approach, SURUHORU plating was performed, and the double-sided flexible patchboard was produced. Test evaluation was carried out like [patchboard / this] the example 1. The obtained result is shown table 2.
[0090]
[Table 2]
Evaluation criteria Example 1 Example 1 of a comparison Bond strength (kg/cm2)
between a lower layer wiring layer and the 1st polyimide layers 2.25 1.55 Between the upper wiring layer and the 3rd polyimide layers 1.85 1.40 SURUHORU dependability (the number of cycles) 100 -- < -- 20
[0091] Table 2 shows that the double-sided flexible patchboard of this invention is excellent in the upper wiring layer and the bond strength of a between at the laminating polyimide layer and the lower layer wiring layer list. Moreover, it turns out that it excels also in the flow dependability of SURUHORU.
[0092]
[Effect of the Invention] It is made to flow through between wiring of both sides of a double-sided flexible patchboard with high productivity and high dependability, and between an insulating layer (especially polyimide layer) and the conductive layer (especially copper layer) of the both sides, high adhesion can be secured, and it can form with the additive process which can moreover finize a circuit pattern, and can avoid

producing curl further according to this invention.

[Translation done.]

* NOTICES *

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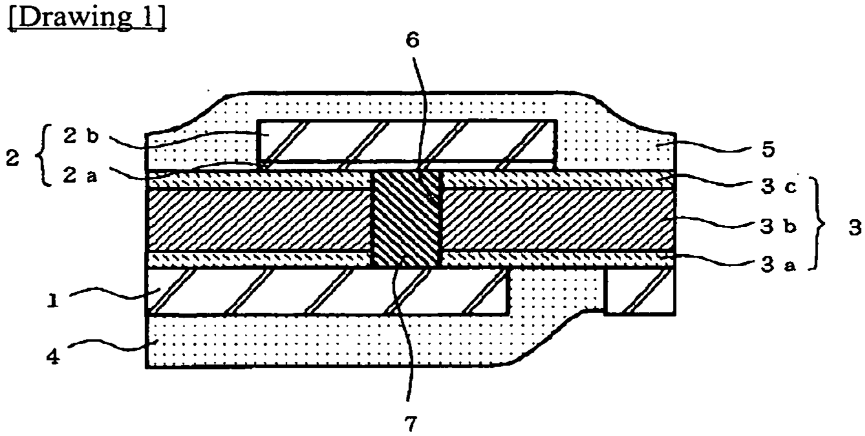
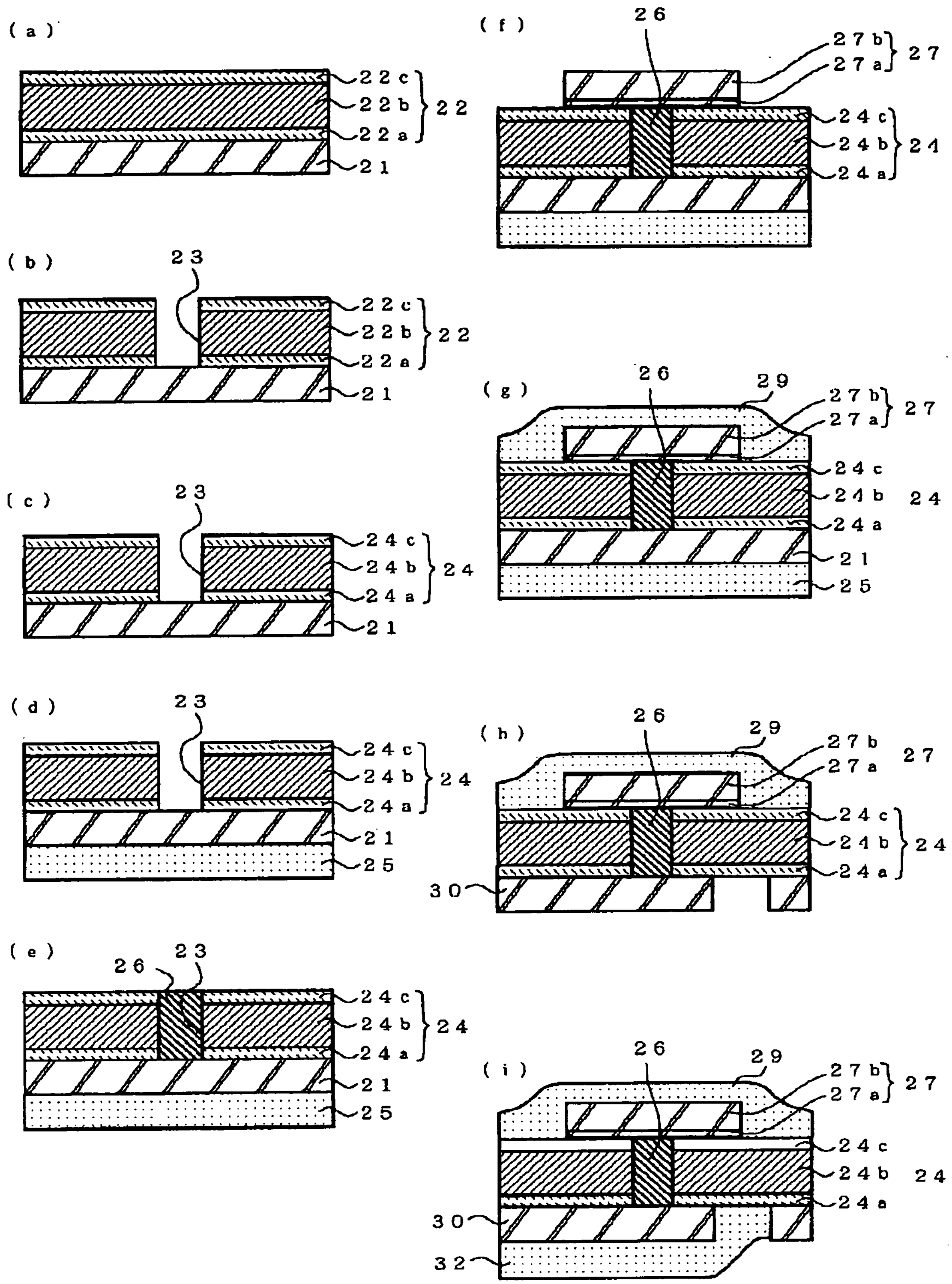
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

[Drawing 1]



[Drawing 2]


(a)
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(h)
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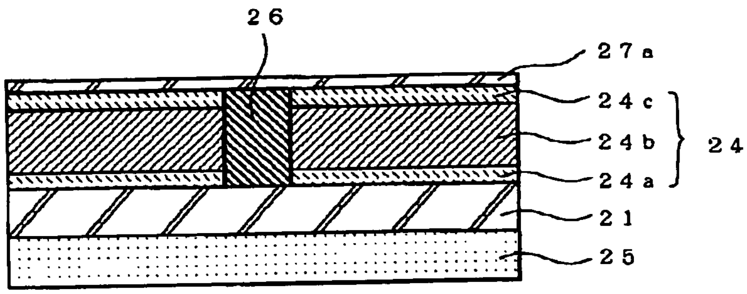
32

[Drawing 3]

(f1)



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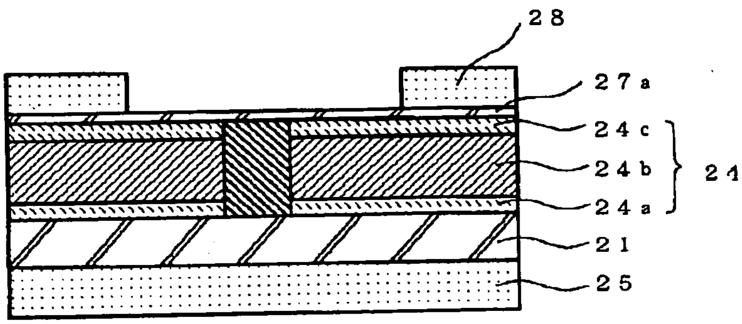

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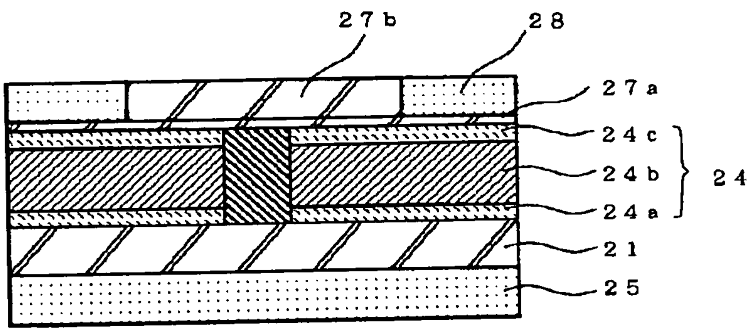

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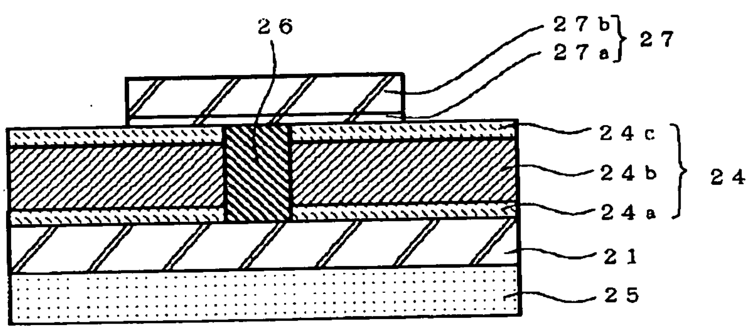
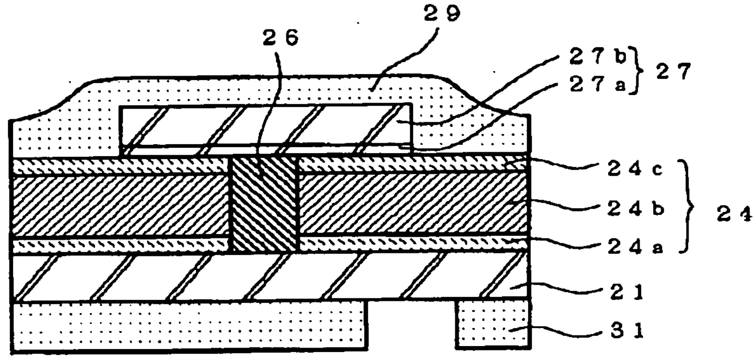
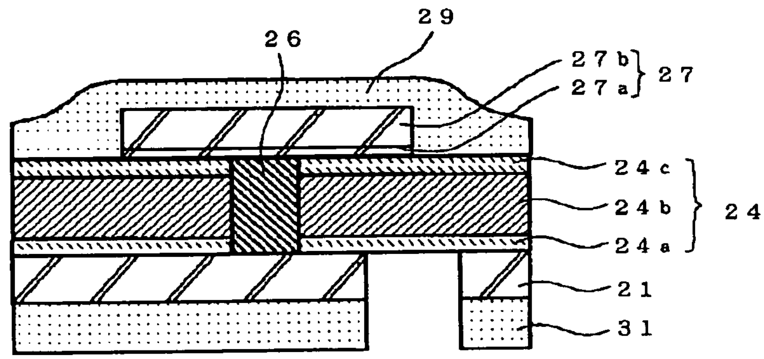


[Drawing 4]

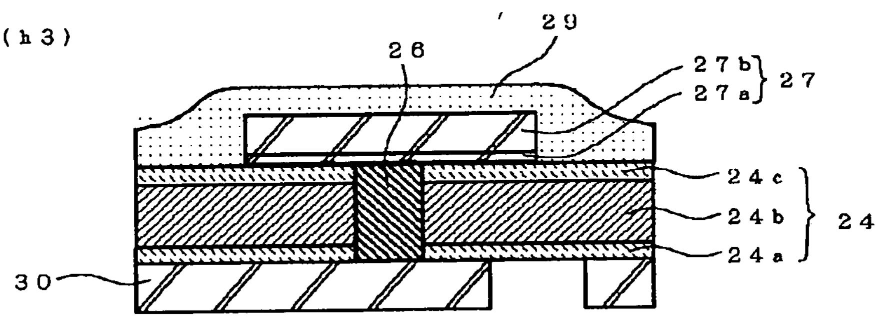
(h 1)



(h 2)



(h 3)



[Translation done.]